

**SECTION 09 51 00**  
**ACOUSTICAL CEILINGS**

**PART 1- GENERAL**

**1.1 DESCRIPTION**

- A. Metal ceiling suspension system for acoustical ceilings.
- B. Acoustical units.

**1.2 RELATED WORK**

- A. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS for additional LEED requirements.
- B. Section 01 81 19, INDOOR AIR QUALITY REQUIREMENTS for VOC limit.
- C. Color, pattern, and location of each type of acoustical unit, metal suspension system and custom perimeter trim:  
Section 09 06 00, SCHEDULE FOR FINISHES.
- D. Access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.

**1.3 SUBMITTAL**

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Samples:
  - 1. Acoustical units, each type, with label indicating conformance to specification requirements.
  - 2. Colored markers for units providing access.
- C. Manufacturer's Literature and Data:
  - 1. Ceiling suspension system, each type, showing complete details of installation.
  - 2. Acoustical units, each type.
- D. Manufacturer's Certificates: Acoustical units, each type, in accordance with specification requirements.
- E. LEED Submittals:
  - 1. Credits MR 4.1 & 4.2: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
    - a. Include statement indicating costs for each product containing recycled content.
  - 2. Credits MR 5.1 & 5.2: For products manufactured within 500 miles of project site *and* whose raw materials are extracted, harvested or recovered, within 500 miles of the project site, documentation indicating the location and distance of material manufacturer and point of extraction, harvest, or recovery for each raw material from the Project site.

- a. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
3. Credit MR 7: Certificates of chain of custody signed by manufacturers certifying that products specified to be made of certified wood were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2, "Principles and Criteria." Include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.
  - a. Include statement indicating costs for each wood based product.
4. Credit EQ 4.1: Manufacturer's product data for installation adhesives and sealants applied on site and within the vapor barrier, including printed statement of VOC content (in g/L).
5. Credit EQ 4.2: Manufacturer's product data for installation paints and coatings applied on-site and within the vapor barrier, including printed statement of VOC content (in g/L).
6. Credit EQ 4.4:
  - a. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde.
  - b. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.

#### 1.4 DEFINITIONS

- A. Standard definitions as defined in ASTM C634.
- B. Terminology as defined in ASTM E1264.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.
- B. American Society for Testing and Materials (ASTM):
  - A641/A641M-03.....Zinc-coated (Galvanized) Carbon Steel Wire
  - A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip Process
  - C423-07.....Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - C634-02 (E2007).....Standard Terminology Relating to Environmental Acoustics
  - C635-04.....Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
  - C636-06.....Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels

E84-07.....Surface Burning Characteristics of Building  
Materials  
E119-07.....Fire Tests of Building Construction and  
Materials  
E413-04.....Classification for Rating Sound Insulation.  
E580-06.....Application of Ceiling Suspension Systems for  
Acoustical Tile and Lay-in Panels in Areas  
Requiring Seismic Restraint  
E1264-(R2005).....Classification for Acoustical Ceiling Products

**PART 2- PRODUCTS****2.1 MANUFACTURERS**

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Armstrong World Industries, Inc. or comparable products by one of the following:
1. CertainTeed Corp.
  2. Chicago Metallic Corporation.
  3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. LEED Requirements:
1. Recycled Content of Steel Products: Provide steel products with minimum 25% post-consumer recycled content.
  2. Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
  3. Provide installation adhesives, sealants, paints, and coatings applied on site and within the vapor barrier, that comply with VOC limits outlined in Division 01 Section "Indoor Air Quality Requirements."
  4. Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin."

**2.2 METAL SUSPENSION SYSTEMS**

- A. Products:
1. ACC-1 and ACT-2: Prelude XL 15/16 inch Exposed Tee System.
  2. ACT-1: Silhouette XL 1/8 inch Reveal 9/16 inch Bolt Slot System.
  3. ACC-1: Woodworks Flat Suspension System
    - a. Components: T-bar sections shall be galvanized cold-roll steel bonderized.
    - b. Finish: Steel parts shall be chemically cleansed hot dipped galvanized steel.
    - c. Hanger System: Aircraft Griplock Hanging Cable System.
    - d. Drywall Grid Back bracing System.

- B. ASTM C635, heavy-duty system, except as otherwise specified.
  - 1. Ceiling suspension system members may be fabricated from either of the following unless specified otherwise.
    - a. Galvanized cold-rolled steel, bonderized.
  - 2. Use same construction for cross runners as main runners. Use of lighter-duty sections for cross runners is not acceptable.
- C. Exposed grid suspension system for support of lay-in panels:
  - 1. Exposed grid width not less than 22 mm (7/8 inch) with not less than 8 mm (5/16 inch) panel bearing surface.
  - 2. Fabricate wall molding and other special molding from the same material with same exposed width and finish as the exposed grid members.
  - 3. On exposed metal surfaces apply baked-on enamel flat texture finish in color to match adjacent acoustical units unless specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 4. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 30 percent.
  - 5. Fire-Rated, Hot-Dip Galvanized, G30 , Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, hot-dip galvanized according to ASTM A 653/A 653M, G30 coating designation, with prefinished, cold-rolled, 9/16-inch- (14-mm-) wide by 1-3/4 inch(44 mm) high.
    - a. Structural Classification: Heavy-duty system.
    - b. Face Finish: Painted, as specified in Section 09 06 00, SCHEDULE FOR FINISHES.
  - 6. Warranty: 30 year Performance Guarantee and Warranty.

### **2.3 PERIMETER SEAL**

- A. Vinyl, polyethylene or polyurethane open cell sponge material having density of 1.3 plus or minus 10 percent, compression set less than 10 percent with pressure sensitive adhesive coating on one side.
- B. Thickness as required to fill voids between back of wall molding and finish wall.
- C. Not less than 9 mm (3/8 inch) wide strip.

### **2.4 WIRE**

- A. ASTM A641.
- B. For wire hangers: Minimum diameter 2.68 mm (0.1055 inch).
- C. For bracing wires: Minimum diameter 3.43 mm (0.1350 inch).

### **2.5 ANCHORS AND INSERTS**

- A. Use anchors or inserts to support twice the loads imposed by hangers attached thereto.

**B. Hanger Inserts:**

1. Fabricate inserts from steel, zinc-coated (galvanized after fabrication).
2. Nailing type option for wood forms:
  - a. Upper portion designed for anchorage in concrete and positioning lower portion below surface of concrete approximately 25 mm (one inch).
  - b. Lower portion provided with not less than 8 mm (5/16 inch) hole to permit attachment of hangers.
3. Flush ceiling insert type:
  - a. Designed to provide a shell covered opening over a wire loop to permit attachment of hangers and keep concrete out of insert recess.
  - b. Insert opening inside shell approximately 16 mm (5/8 inch) wide by 9 mm (3/8 inch) high over top of wire.
  - c. Wire 5 mm (3/16 inch) diameter with length to provide positive hooked anchorage in concrete.

**C. Clips:**

1. Galvanized steel.
2. Designed to clamp to steel beam or bar joists, or secure framing member together.
3. Designed to rigidly secure framing members together.
4. Designed to sustain twice the loads imposed by hangers or items supported.

**D. Tile Splines: ASTM C635.****2.6 CARRYING CHANNELS FOR SECONDARY FRAMING**

- A. Fabricate from cold-rolled or hot-rolled steel, black asphaltic paint finish, free of rust.
- B. Weighing not less than the following, per 300 m (per thousand linear feet):

Size mm	Size Inches	Cold-rolled Kg Pound	Hot-rolled Kg Pound
38	1 1/2	215.4 475	508 1120
50	2	267.6 590	571.5 1260

**2.7 ACOUSTICAL UNITS - ACT-1**

- A. Product: Ultima, Tegular, Fine Texture.
- B. Edge Profile: 9/16" beveled tegular.
- C. Item No. 1912.
- D. Dimensions: 24 inches by 24 inches by 3/4 inch.

- E. Minimum NRC (Noise Reduction Coefficient): 0.70 unless specified otherwise: ASTM C423.
- F. Minimum AC: Not applicable.
- G. Minimum CAC (Ceiling Attenuation Class): 35.
- H. Fire Rating: Class A Flame Spread: ASTM 84.
- I. Manufacturers standard finish, minimum Light Reflectance (LR) coefficient of 0.90 on the exposed surfaces, except as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Sag Resistance: HumiGuard Plus.
- K. Antimicrobial Fungicide Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21; BioBlock Plus.
- L. VOC Formaldehyde: No added formaldehyde.
- M. Durability Characteristics:
  - 1. Washable.
  - 2. Impact resistant.
  - 3. Scratch resistant.
  - 4. Soil resistant.
- N. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes 70 to 80 percent by weight.
- O. Material: Wet-formed mineral fiber with Durabrite acoustically transparent membrane.
- P. ASTM E1264 Classification: Type IV, Form 2, Pattern E.
- Q. Insulation Value: R factor of 2.2 (BTU Units).
- R. Weight: 1.05 psf.
- S. Warranty: 30 year Performance Guarantee and Warranty.

## **2.8 ACOUSTICAL UNITS - ACT-2**

- A. Product: Woodworks, Tegular Solid (Unperforated) and Perforated.
- B. Edge Profile: 15/16" Vector.
- C. Item Nos. 6802 and 6803.
- D. Dimensions: 24 inches by 24 inches by 3/4 inch.
- E. Minimum NRC (Noise Reduction Coefficient): 0.40 unless specified otherwise: ASTM C423.
- F. Minimum AC: Not applicable.
- G. Minimum CAC (Ceiling Attenuation Class): 28 range unless specified otherwise: ASTM E413.
- H. Fire Rating: Class A Flame Spread: ASTM 84.

- I. Manufacturers standard finish, as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes 92 percent by weight.
- K. Material: Fire retardant particle board with face cut veneers.
- L. Veneer Selection: Constants (real wood veneers) maple.
- M. ASTM E1264 Classification: Composite, Fire Class A.
- N. Weight: 2.75 psf.
- O. Warranty: 1 year Performance Guarantee and Warranty.

## **2.9 ACOUSTICAL UNITS - ACC-1**

- A. Product: Woodworks Plank System, solid (non perforated).
- B. Edge Profile: Manufacturer's standard.
- C. Item No.: Not applicable.
- D. Dimensions: Custom width by Custom Length by 3/4 inch.
- E. Minimum NRC (Noise Reduction Coefficient): 0.40 unless specified otherwise: ASTM C423.
- F. Minimum AC: Not applicable.
- G. Minimum CAC (Ceiling Attenuation Class): 28 range unless specified otherwise: ASTM E413.
- H. Fire Rating: Class A Flame Spread: ASTM 84.
- I. Manufacturers standard finish, as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.
- J. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes 92 percent by weight.
- K. Material: Fire retardant particle board with face cut veneers.
- L. Veneer Solution: Constants (red wood veneers) maple.
- M. ASTM E1264 Classification: Composite, Fire Class A.
- N. Weight: 2.75 psf.
- O. Warranty: 1 year Performance Guarantee and Warranty.

## **2.10 CUSTOM PERIMETER TRIM - ACT-2**

- A. Axiom-Knife Edge Custom Perimeter Trim.
  - 1. Edge trim system with six inch wide horizontal face for suspended ceiling system, extruded aluminum alloy 6063 trim channel, extruded aluminum, factory-finished in factory-applied baked polyester paint.
  - 2. 10 foot straight sections; plus factory-welded and finished seamless corners with 12 inch legs.
  - 3. Attachment to grid system is provided by the specially designed Axiom tee-bar connection clips (AXTBC) (AX-V-TBC) or hanging clips (AX2HGC), which lock into the Axiom Knife-Edge trim channel and are

screw-attached to the web of the intersecting Armstrong suspension system members. Sections of trim are joined at the vertical face using the Axiom splice plate (AX4SPLICE).

4. Axiom Knife-Edge Trim Channel: with special bosses formed for attachment to the Axiom tee-bar connection clip or hanging clip; commercial quality.
5. Axiom Splice Plate (AX4SPLICE): Galvanized steel finish; formed to fit into special bosses and locked in place with 4 factory-installed screws.
6. Axiom Knife-Edge Alignment Clip (AXKEALIGN): Commercial quality aluminum alignment plate that snaps into plenum side of horizontal detail for alignment of adjoining sections; blocks light leaks from above.
7. Axiom Tee-Bar Connection Clip (AXTBC): Galvanized steel (unfinished) (finish to match trim channel) formed to fit into special bosses and locked in place by factory-installed screws and attached to specified suspension system.
8. Axiom Hanging Clip (AX2HGC): Commercial quality galvanized steel (unfinished) (finish to match trim channel) formed to lock into special bosses and attach to specified suspension system members.
9. Axiom Drywall Trim (AXDWT): Commercial quality extruded aluminum straight sections finished with chemical conversion coating to provide integrated taping flange for integrated 5/8" drywall finish.
10. Manufacturer's standard finish as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

## **2.11 CUSTOM PERIMETER TRIM - ACC-1**

### **A. Axiom-Classic Custom Perimeter Trim:**

1. Components: Edge trim system for suspended ceiling system, extruded aluminum alloy 6063 trim channel, 10 foot straight profiles to minimum 24 inches for 2 through 8 inch high inside and outside radii for acoustical and for drywall applications.
2. Axiom Trim Channel: 4 inch wide face with 3/4 inch horizontal legs, straight or curved sections with special bosses formed for attachment to the Axiom tee-bar connection clip or hanging clip; commercial quality, extruded aluminum, factory-finished in factory-applied baked polyester paint.
3. Axiom Outside Corner Posts (Straight Only): Commercial quality extruded aluminum sections formed to match the Axiom trim channel profile; pre-assembled with built-in splice plates that connect to straight Axiom sections; 7/8 inch x 7/8 inch X 4-inch; factory-finished in factory-applied baked polyester paint.



4. Axiom Inside Corners (Straight Only): Commercial quality extruded aluminum sections formed to match the Axiom trim channel profile that connect to straight Axiom sections, 12 inch x 3/4 inch x 4-inch factory-finished in factory-applied baked polyester.
5. Accessories:
  - a. AXHGC - Hanging clip, commercial quality aluminum, unfinished, used to align grid members that extend beyond the lower edge of the trim.
  - b. AX2HGC - Hanging clip, commercial quality aluminum, unfinished, used when suspension wires must be attached directly to the trim sections.
  - c. AXSPLICE - Splice with set screws, galvanized steel, unfinished, used to attached factory-mitered inside corners
  - d. AX4SPLICE - Splice with set screws, galvanized steel, unfinished, used to attach joints between sections of trim.
  - e. AXTBC - T-bar Connector Clip, commercial grade aluminum, unfinished, used to attach channel trim to supporting suspension members.
  - f. AXSPTHDC - Perimeter Trim Hold Down Clip used to secure cut edges of metal panels at the Axiom trim.
  - g. AXBTSTR - Drywall Bottom Trim Straight, extruded aluminum, 120 inches x 1-9/64 inch x 27/32 inch, used to finish edges of 5/8 inch drywall that is applied to the bottom surface of the Axiom.
  - h. AXBTCUR - Drywall Bottom Trim Curved, extruded aluminum, 120 inches x 1-9/64 inch x 27/32 inch, used to finish edges of 5/8 inch drywall that is applied to the bottom surface of the Axiom.
6. Manufacturer's standard finish, as specified otherwise in Section 09 06 00, SCHEDULE FOR FINISHES.

## **2.12 ACCESSORIES - ACT 2**

- A. Fiberglass Infill Panel:
  1. Item No. 8200100.
  2. Dimensions: 24 inches by 24 inches by 1 inch.
  3. Color: Black.

## **2.13 ACCESS IDENTIFICATION**

- A. Use colored markers with pressure sensitive adhesive on one side.
- B. Make colored markers of paper or plastic, 6 to 9 mm (1/4 to 3/8 inch) in diameter.
- C. Use markers of the same diameter throughout building.
- D. Color Code: Use following color markers for service identification:  
Color.....Service  
Red.....Sprinkler System: Valves and Controls

Green.....Domestic Water: Valves and Controls  
Yellow.....Chilled Water and Heating Water  
Orange.....Ductwork: Fire Dampers  
Blue.....Ductwork: Dampers and Controls  
Black.....Gas: Laboratory, Medical, Air and Vacuum

**PART 3 - EXECUTION****3.1 CEILING TREATMENT**

- A. Treatment of ceilings shall include sides and soffits of ceiling beams, furred work 600 mm (24 inches) wide and over, and vertical surfaces at changes in ceiling heights unless otherwise shown. Install acoustic tiles after wet finishes have been installed and solvents have cured.
- B. Lay out acoustical units symmetrically about center lines of each room or space unless shown otherwise on reflected ceiling plan.
- C. Moldings:
  - 1. Install metal wall molding at perimeter of room, column, or edge at vertical surfaces.
  - 2. Install special shaped molding at changes in ceiling heights and at other breaks in ceiling construction to support acoustical units and to conceal their edges.
- D. Perimeter Seal:
  - 1. Install perimeter seal between vertical leg of wall molding and finish wall, partition, and other vertical surfaces.
  - 2. Install perimeter seal to finish flush with exposed faces of horizontal legs of wall molding.
- E. Fire-Rated System:
  - 1. Total assembly, consisting of the ceiling suspension system, acoustical units, penetrations, structural components and floor or roof construction above, shall have a 1 hour fire rating based on tests conducted in conformance with ASTM E119.
  - 2. Provide concealed fire protection around penetrations in ceilings for electric and mechanical work, and other penetrations as required to maintain the integrity of the fire-rated assembly.
  - 3. Install fire rated ceiling systems to conform to tested assembly.

**3.2 CEILING SUSPENSION SYSTEM INSTALLATION**

- A. General:
  - 1. Install metal suspension system for acoustical tile and lay-in panels in accordance with ASTM C636, except as specified otherwise.
  - 2. Use direct or indirect hung suspension system or combination thereof as defined in ASTM C635.
  - 3. Support a maximum area of 1.48 m<sup>2</sup> (16 sf) of ceiling per hanger.

4. Prevent deflection in excess of  $1/360$  of span of cross runner and main runner.
5. Provide extra hangers, minimum of one hanger at each corner of each item of mechanical, electrical and miscellaneous equipment supported by ceiling suspension system not having separate support or hangers.
6. Provide not less than 100 mm (4 inch) clearance from the exposed face of the acoustical units to the underside of ducts, pipe, conduit, secondary suspension channels, concrete beams or joists; and steel beam or bar joist unless furred system is shown,
7. Use main runners not less than 1200 mm (48 inches) in length.
8. Install hanger wires vertically. Angled wires are not acceptable except for seismic restraint bracing wires.

B. Anchorage to Structure:

1. Concrete:

- a. Install hanger inserts and wire loops required for support of hanger and bracing wire in concrete forms before concrete is placed. Install hanger wires with looped ends through steel deck if steel deck does not have attachment device.
- b. Use eye pins or threaded studs with screw-on eyes in existing or already placed concrete structures to support hanger and bracing wire. Install in sides of concrete beams or joists at mid height.

2. Steel:

- a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels for attachment of hanger wires.
  - (1) Size and space carrying channels to insure that the maximum deflection specified will not be exceeded.
  - (2) Attach hangers to steel carrying channels, spaced four feet on center, unless area supported or deflection exceeds the amount specified.
- b. Attach carrying channels to the bottom flange of steel beams spaced not 1200 mm (4 feet) on center before fire proofing is installed. Weld or use steel clips to attach to beam to develop full strength of carrying channel.
- c. Attach hangers to bottom chord of bar joists or to carrying channels installed between the bar joists when hanger spacing prevents anchorage to joist. Rest carrying channels on top of the bottom chord of the bar joists, and securely wire tie or clip to joist.

C. Direct Hung Suspension System:

1. As illustrated in ASTM C635.

2. Support main runners by hanger wires attached directly to the structure overhead.
  3. Maximum spacing of hangers, 1200 mm (4 feet) on centers unless interference occurs by mechanical systems. Use indirect hung suspension system where not possible to maintain hanger spacing.
- D. Indirect Hung Suspension System:
1. As illustrated in ASTM C635.
  2. Space carrying channels for indirect hung suspension system not more than 1200 mm (4 feet) on center. Space hangers for carrying channels not more than 2400 mm (8 feet) on center or for carrying channels less than 1200 mm (4 feet) on center so as to insure that specified requirements are not exceeded.
  3. Support main runners by specially designed clips attached to carrying channels.
- E. Ceiling Bracing System:
1. Construct system in accordance with ASTM E580.
  2. Connect bracing wires to structure above as specified for anchorage to structure and to main runner or carrying channels of suspended ceiling at bottom.

### **3.3 ACOUSTICAL UNIT INSTALLATION**

- A. Cut acoustic units for perimeter borders and penetrations to fit tight against penetration for joint not concealed by molding.
- B. Install lay-in acoustic panels in exposed grid with not less than 6 mm (1/4 inch) bearing at edges on supports.
1. Install tile to lay level and in full contact with exposed grid.
  2. Replace cracked, broken, stained, dirty, or tile not cut for minimum bearing.
- C. Tile in concealed grid upward access suspension system:
1. Install acoustical tile with joints close, straight and true to line, and with exposed surfaces level and flush at joints.
  2. Make corners and arises full, and without worn or broken places.
  3. Locate acoustical units providing access as specified under Article, ACCESS.
- D. Adhesive applied tile:
1. Condition of surface shall be in accordance with ASTM D1779, Note 1, Cleanliness of Surface, and Note 4, Rigidity of Base Surface.
  2. Size or seal surface as recommended by manufacturer of adhesive and allow to dry before installing units.
- E. Markers:
1. Install markers of color code specified to identify the various concealed piping, mechanical, and plumbing systems.

2. Attach colored markers to exposed grid on opposite sides of the units providing access.
3. Attach marker on exposed ceiling surface of upward access acoustical unit.

**3.4 CLEAN-UP AND COMPLETION**

- A. Replace damaged, discolored, dirty, cracked and broken acoustical units.
- B. Leave finished work free from defects.

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